BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

As rescanning documents *will not* correct images, please do not report the images to the Image Problem Mailbox.

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : G07C 5/00, B60K 31/00 — A1

(11) International Publication Number: WO 00/07150

(43) International Publication Date: 10 February 2000 (10.02.00)

(21) International Application Number: PCT/NL99/00464

(22) International Filing Date: 19 July 1999 (19.07.99)

(30) Priority Data:
1009775 30 July 1998 (30.07.98) NL

(71) Applicant: UNIVERSITEIT TWENTE [NL/NL]; P.O. Box 217, NL–7500 AE Enschede (NL).

(72) Inventors: VAN DER VOORT, Mascha, Cécile; Heuvellaan 5, NL–2803 DV Gouda (NL). MAARSEVEEN, Martinus, Franciscus, Antonius, Maria; Holskottelanden 2, NL–7542 KN Enschede (NL). DOUGHERTY, Mark, Sebastian; Tegelbruksvägen 6, S–780 41 Gagnef (SE).

(74) Agents: LOUËT, Feisser, Arnold et al.; Arnold & Siedsma, Sweelinckplein 1, NL–2517 GK Den Haag (NL).

(81) Designated States: JP, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.
In English translation (filed in Dutch).

(54) Title: SYSTEM AND METHOD FOR DRIVING A MOTOR VEHICLE IN AN EFFICIENT MANNER

(57) Abstract

A system of advising the driver of a motor vehicle as regards the efficiency of his driving style while driving. Registration means determine internal factors of the vehicle, and calculating means determine on the basis of determined factors to what extent the driver's actual driving style deviates from a normative driving style. Interface means present to the driver information as regards the efficiency of his driving style.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

SYSTEM AND METHOD FOR DRIVING A MOTOR VEHICLE IN AN EFFICIENT MANNER

The invention relates to a system of advising the driver of a motor vehicle as regards the efficiency of his or her driving style while driving, comprising registration means for determining internal factors of the vehicle. Internal factors of the vehicle may for example include the vehicle speed, the gear position, the engine speed and the fuel consumption. Such internal vehicle factors are usually available to the driver, so that he will be able to adapt his style of driving in response thereto or take action to change one or more factors.

The invention relates in particular to the driving of passenger cars. The term efficient driving style is understood to mean a driving style which involves a minimal fuel consumption and a minimum degree of environmental pollution.

For several reasons, and in particular for reasons of fuel economy, systems and methods have been developed for stimulating a driver to adopt a more efficient driving style. It is in particular important thereby that the fuel consumption of the motor vehicle be minimized, whilst allowing a driving style that is still acceptable to the driver and his environment.

In order to stimulate drivers to adopt a driving style which reduces the fuel consumption, systems are known wherein the gas pressure in the inlet manifold of the vehicle's engine is measured, whereby the measured value is presented to the driver. The driver is then encouraged to drive in such a manner that the measured gas pressure is maintained at the highest possible level. It is indeed correct that the gas pressure in the

inlet manifold is a good measure for the momentaneous fuel consumption when driving in a particular gear (with a particular transmission ratio). However, when a dynamic driving pattern is followed, that is, a driving pattern which involves changing transmission ratios and adaptations to the conditions in which the vehicle is being driven, the use of the measured gas pressure in the inlet manifold as an indication for the efficiency of the driving style appears to be a poor measure thereof. In addition, in practice it has appeared to have a negative effect when indications being presented to the driver change constantly and often quickly, as is the case with the measured pressure values in the inlet manifold.

The revolution counter of a motor vehicle can also play a role in inducing a driver to adopt a more efficient driving style, because it possible to select the highest possible gear, that is, the highest gear that is possible without the engine speed sinking below a predetermined minimum level, on the basis of the engine speed in combination with a particular driving speed. The driver needs to know thereby what engine speed is minimally required, which engine speed furthermore depends on the motor output. Consequently, only persons having a certain level of technical knowledge will be able to drive a motor vehicle in an efficient manner on the basis of the engine speed as an indication thereof.

The object of the invention is to provide a system and a method of stimulating the driver of a motor vehicle to adopt an efficient driving style, wherein the driver is stimulated in an effective manner to drive efficiently, without the driver and/or the passengers of the vehicle and/or the environment of the vehicle experiencing the driving style which the driver is being stimulated to adopt as undesirable or unacceptable.

In order to accomplish that objective, the system according to the invention comprises calculating means for determining on the basis of the factors determined by the registration means to what extent the driver's actual driving style deviates from a normative driving style, whereby the actual driving style and the normative driving style are determined by the calculation means while driving on the basis of factors determined by the registration means, and the system furthermore comprises interface means for presenting recommendation signals to the driver in dependence on that which is being determined by the calculation means.

The term recommendation signal, hereinafter also briefly called signal, is understood to mean not a signal which indicates to the driver that he is doing something wrong or that something is taking place less optimally, but a signal which indicates to the driver how to drive more efficiently, that is, it is indicated to the driver what to do or what must happen.

The term normative is understood to mean a standard which is a measure for an efficient situation. Depending on the current motor vehicle conditions, the route which the motor vehicle is following and the acceptability of the possible driving style, an optimum driving style, at least a satisfactory driving style, of the driver of the motor vehicle can be determined on the basis of certain factors, which driving style is indicated by the term normative driving style.

Internal factors of the vehicle may be considered to include the vehicle speed, the transmission ratio (gear position), the braking force being exerted upon braking of the vehicle, the acceleration or deceleration of the vehicle, the gas pedal position, the steering wheel position, the angular speed of the steering wheel, the

bends which the vehicle takes, the use or non-use of the clutch, the engine speed and the fuel consumption of the vehicle. All these factors can be measured by registration means which are provided with detectors and possibly with processors for processing the measure value or values into a signal which is characteristic of the factor in question.

Besides means for determining said internal factors, the system may also comprise means for determining ambient factors, such as the gradient of the road on which the vehicle is driving, the allowed maximum vehicle speed, the distance to a vehicle ahead, the difference in speed with a vehicle ahead, the position of the motor vehicle and the direction of movement of the motor vehicle.

The gradient of the road on which the vehicle is being driven can for example be determined on the basis of the position of a pendulum in the vehicle, or by means of other detectors which are known per se, which measure the apparent gradient of the surface on which the vehicle is present, whereby the measured value is corrected so as to eliminate the influence of possible acceleration or deceleration of the vehicle that may interfere with said measurement.

The position of the vehicle can be determined by means of the well-known GPS system (Global Positioning System), which makes it possible to determine the position of the vehicle precisely, on the basis of which a number of additional factors can be derived, such as the speed, the direction of travel, acceleration/deceleration, etc. Moreover, it is possible to determine the allowed maximum speed on the basis of the position and the direction of movement of the vehicle, at least if sufficient relevant road information is contained in the system. Furthermore it is possible to provide roads

with beacons which transmit signals, which signals can be received by a receiver in the vehicle and which include information, for example as regards the allowed maximum speed.

The distance to a vehicle ahead and also the difference in speed with the vehicle ahead can be determined by means of a radar system which is mounted in the vehicle, as is also customary with vessels.

Preferably, the calculation means constantly determine the status, such as reversing, turning, overtaking, lane changing, parking, idling, creeping, shifting, uphill driving, downhill driving, accelerating, decelerating, cruising, etc. while driving, for example every period of less than 2 seconds, more preferably every period of less than 1 second.

In practice it has become apparent that good results can be obtained when the aforesaid status is determined three times per second.

On the basis of the internal factors and/or the ambient factors determined by the registration means, the driver's actual driving style can be determined and be registered by means of parameters, such as the time the vehicle engine idles in certain circumstances, for example after the engine has been started and before the vehicle is driven off, and/or the number of times a gear shift (i.e. gear change) takes place per unit time and/or the number of times braking takes place per unit time, whether or not under particular circumstances, and/or the degree of acceleration and/or the position of the gas pedal and/or the speed at which certain bends are taken, etc. The same parameters used for determining the actual driving style can be used for determining and registering a normative driving style, which normative

driving style is calculated on the basis of ambient factors, using predetermined standards which define the normative driving style on the basis of the measured factors.

Differences between the actual driving style and the normative driving style can be determined by comparing the various parameters and be tested against predetermined criteria, in order to provide information which can be made available to the driver. Said information must be of a predetermined quality which effectively stimulates the driver to adopt a more efficient driving style. The term efficient in this context is understood to mean a driving style which leads to a reduced fuel consumption.

The measure or the value by which a factor is measured or registered can be averaged over a predetermined period, for example a period of less than 2 minutes, more preferably a period of less than 1 minute. Such an average value may be a good measure by which a particular aspect of the driving style can be determined. Good results have been obtained with values averaged over a period of 1/3 minute.

When determining the normative driving style, that which is acceptable in the driver's perception must be taken into consideration, which means that there must be scope for a certain degree of driveability. To that end, certain minimum or maximum values of certain aspects of the normative driving style can be determined, which values can be input into the system as basic information.

Preferably, a vehicle speed-dependent minimum acceleration value is determined for the normative driving style which is higher when the vehicle speed is

lower and which consequently is lower when the vehicle speed is higher. In practice it has become apparent that a particular, low acceleration value is not acceptable when the vehicle speed is low, whilst the same acceleration value is indeed acceptable to the driver when the vehicle speed is higher.

Preferably, the minimum normative acceleration value is higher than 0.8 m/s2 when the vehicle speed is less than 20 km/h, and less than 0.8 m/s2 when the vehicle speed is more than 60 km/h, and more preferably the minimum normative acceleration value is higher than 1 m/s2 when the vehicle speed is less than 20 km/h and lower than 0.6 m/s2 when the vehicle speed is more than 60 km/h. This basic information, wherein a particular minimum normative acceleration value is linked to a particular vehicle speed, is registered in the system.

Preferably, a maximum deceleration value is determined and registered for the normative driving style in a similar manner, which maximum normative deceleration value is preferably less than 0.45 g and more preferably less than 0.35 g. In practice good results have been obtained with a normative deceleration value set at 0.3 g. Braking with a higher deceleration value appears to be considered undesirable by the driver, except in case of an emergency stop.

Preferably, the system's calculation means constantly calculate the fuel consumption and/or the possible motor output that can be expected when a higher gear position is used at the actual vehicle speed or the actual acceleration/deceleration. On the basis of the outcome of said calculations it can be determined whether the current gear position is too low, so that the driver may or may not be advised to shift to a higher gear. Of course the allowed minimum engine speed must be taken

into account thereby.

Preferably, the system comprises interface means which are capable of producing a number of predetermined visual and/or auditive signals. Said auditive signals may consist of a number of predetermined brief verbal recommendations, from which one or more may be selected for being presented to the driver. Said visual signals may consist of one or more coloured or non-coloured lights, whereby the colour, the colour combination, the intensity and/or the times of turning on and off are typical of a particular recommendation to the driver, which recommendation can be selected from a number of predetermined recommendations which have been programmed into the system.

Preferably, said visual signals consist of a text which is displayed on a screen. Such a text must be written in sufficiently large letters, of course, and the screen must be mounted in a favourable position in order to allow the driver to read the text in the safest possible manner. A brief acoustic signal may be sounded whenever a next text is displayed.

Preferably, the calculation means calculate to what extent the driver's actual driving style deviates from the normative driving style, which is presented to the driver by the interface means. This information, or a recommendation based on said information, is presented to the driver as soon as possible after the normative driving style and the actual driving style have been determined and compared with each other over a particular period of time. This may be a fixed period, for example a period of 3 seconds. Depending on the aspects of the driving style to which the respective recommendation relates, said period may be longer or shorter. Certain recommendations are preferably given

immediately after a period a particular status has lasted. Thus, the recommendation to shift to a higher gear position sooner may be given directly after an acceleration manoeuvre has taken place.

Especially when it has been derived from the ambient factors that the driver has a large degree of freedom in selecting his own driving style, the communication to the driver concerning the degree to which the actual fuel consumption over a particular period of time deviates from the normative fuel consumption may constitute an effective stimulus to adopt a more efficient driving style resulting in an improved fuel economy. Such a recommendation need not always be accompanied with a detailed recommendation concerning the manner in which the fuel consumption is to be reduced, because the driver, in particular when he is familiar with the system, will generally know how to adapt his driving style in order to reduce the fuel consumption. The period over which the average fuel consumption is determined is preferably shorter than 10 minutes, more preferably shorter than 5 minutes. Good results have been obtained with a period of 3 minutes. When visual interface means are used, the information will be displayed for a certain period of time, for example 30 seconds.

When the actual driving style has not substantially deviated from the normative driving style for a particular period, preferably a period of less than 10 minutes, more preferably a period of less than 5 minutes, a positive communication can be issued to the driver by the interface means. In practice the receipt of a positive communication from time to time has appeared to be an important factor in stimulating the driver to adopt and/or maintain a good driving style. The positive communication may for example be in the

form of a green light which lights up, whether or not intermittently, or an auditive, verbal compliment or a positive text or sign which is displayed on a screen. Said communication is not a signal in the sense of the aforesaid recommendation signal which indicates to the driver how to adapt his current driving style.

In a system wherein recommendations or other information is presented to the driver regarding the extent to which certain aspects of his driving style deviate from the normative driving style, or recommendations or information which is based thereon, a minimum value may be set for each aspect, below which value no recommendation is made or other information is supplied. Preferably, the system comprises setting means for setting said minimum values. This makes it possible to adapt the level at which recommendations are made to the driver in question. Possibly, the driver will be capable of selecting his own settings.

Preferably, the system comprises verification means which verify whether a particular signal can be delivered before said signal is actually delivered by the interface means, whereby certain signals cannot be delivered during one or more of the following situations, for example: turning and/or parking and/or overtaking and/or reversing and/or braking and/or approaching a vehicle ahead more quickly than a predetermined value, for example a value which corresponds to a so-called time to collision of less than 4 seconds, and/or accelerating while approaching a vehicle ahead more quickly than a predetermined value, for example a value which corresponds to a so-called time to collision of 7 seconds.

The term time to collision is understood to mean the time it would take before the vehicle would collide with

a vehicle ahead if the difference in speed would remain constant.

Also other situations in which the making of a particular recommendation or generally the giving of advice will not take place can be programmed into the system, of course. Thus, the verification means may block a recommendation to drive faster in cases where a vehicle ahead is being approached more quickly than a predetermined value.

A recommendation which is blocked by the verification means may be stored, and after a predetermined period of time, for example a period of less than 2 seconds, the verification means can determine anew whether the recommendation is to be delivered as yet. If the recommendation is blocked again, it may be stored again for a predetermined period of time or be removed from the system after a predetermined period of time, depending on the type of recommendation and the particular circumstances.

Preferably, means are present for classifying recommendations which are simultaneously available for delivery by the interface means on the basis of predetermined criteria. Thus, a recommendation to shift gear may be awarded a higher priority than a recommendation to accelerate or decelerate, so that it will be the recommendation to shift gear that is presented to the driver in case of concurrence. Each of the predetermined recommendations may be awarded a priority for each of a number of predetermined situations, so that said means will be capable of determining in dependence on the actual situation whether a particular recommendation will have priority over a particular other recommendation.

The invention furthermore relates to a method for advising the driver of a motor vehicle as regards the efficiency of his or her driving style while driving, wherein registration means determine vehicle factors, wherein calculation means determine on the basis of predetermined factors to what extent the actual driving style deviates from a normative driving style, wherein the actual driving style and the normative driving style are determined while driving by said calculation means on the basis of factors determined by said registration means, and wherein interface means make signals available to the driver.

In order to explain the invention more fully, eight diagrams are shown in the figures. Said diagrams are merely examples of the manner in which a number of aspects of the invention can be implemented.

The status of a motor vehicle can be determined in accordance with the diagram of Figure 1. In this embodiment, the status is determined three times per second by first of all detecting whether the transmission is in reverse gear, and if that is the case, the status is "reversing". If that is not the case, the position of the steering wheel is detected, and if said position deviates to a sufficient degree from the straight position, it is verified whether the vehicle speed is higher than 10 km/h. If that is the case, the status is "turning" (including "overtaking" and "lane changing", if not, the status is "parking".

If there is no substantial steering wheel movement, the average speed over one-third of a second is determined, and if said speed is less than 7.5 km/h, the status is "idling" when the speed is less than 3.6 km/h, whilst the status is "creeping" when the average speed is higher than 3.6 km/h.

When the speed is higher, it is detected whether the clutch is being used, and if that is the case, the status is "shifting". When the clutch is not being used, the road gradient is determined in order to determine the status "uphill driving" or "downhill driving".

Then it is determined whether the status is "accelerating" or "decelerating", and if neither is the case, the status is "cruising".

As described above, the status of the motor vehicle can be determined on the basis of a number of internal factors of the motor vehicle.

The diagram of Figure 2 shows the manner in which a number of recommendations (Advice 0, 1, 2, 3 and 4) are determined, which recommendations are based on a comparison of the actual driving style and the normative driving style (in the figures driving "style" is called driving "behaviour"), wherein the starting point is the gas pedal position as a function of time and the gear position as a function of time, both actually and normatively in both cases. The diagram of Figure 2 relates to an acceleration manoeuvre.

If the correct gear was not selected at the start of an acceleration manoeuvre, the recommendation "you should have started acceleration in .. gear" is made (Advice 0). No recommendation is made when a late gear shift occurs only infrequently or when the deviation of the gas pedal position is only small. If the negative or positive deviation of he gas pedal position is larger than or equal to G (a predetermined value), the recommendation "accelerate faster" (Advice 3) is made when the deviation of the gas pedal position is negative and the recommendation ("accelerate more slowly") is given when the deviation of the gas pedal position from

the normative position is positive.

In a similar manner it is determined, as shown in the left-hand bottom corner of the diagram, whether the recommendation "shift sooner" (Advice 1) or "delay shifting" (Advice 2) is made.

Figure 3 shows a diagram wherein a decision to make a recommendation is made during a deceleration manoeuvre. According to said diagram, the recommendation "anticipate and brake more slowly" is made when the braking force, or the deceleration generated by braking, ranges between ß and ß'. When the braking force is larger than ß1, which corresponds to a deceleration of for example 0.5 g, this is considered to be an emergency stop and it is registered at what moment said emergency stop has taken place in order to use this as a basis for a recommendation at a later stage.

Figure 4 shows a diagram wherein recommendations relating to the status "cruising" are made. The actual driving style is thereby compared to the normative driving style, whereby the optimum gear position is determined. Furthermore, the allowed maximum speed is taken into account, whereby said speed limit can for example be detected via specially arranged roadside beacons, which are capable of transmitting a signal to the motor vehicle.

As is shown in the left-hand part of this diagram, it is first of all determined whether a gear shift actually takes take, which may lead to the recommendation "gear position should be constant during cruising" (Advice 6), after which a recommendation is made as regards the gear position to be used (Advive 7). Said latter recommendation is also made when the same gear position is used continuously and said gear position is not the

optimum (normative) gear position.

In the right-hand part of the diagram it is determined whether the speed limit is being exceeded, which may lead to the recommendation "slow down".

Figure 5 shows a diagram of a verification operation which is constantly being carried out, that is, independently of the ongoing manoeuvre. The status of the motor vehicle is thereby indicated by the following letters: A (accelerating), D (decelerating), C (cruising), P (parking), R (reversing), S (shifting), I (idling), CP (creeping) and T (turning).

It is verified over a particular period of time (t sec.) whether there has been deceleration followed by acceleration within a predetermined period of time (s sec.). If that is the case, it is verified whether the motor vehicle has been turned between said deceleration and said acceleration, and if that is indeed the case, no recommendation is made. If that is not the case, it is verified whether the engine has idled for more than 3 seconds between said deceleration and said acceleration. If that is the case, no recommendation is made, if that is not the case, it is verified whether the brakes have been used during said deceleration. If that is the case, the driver is advised "anticipate, you should have gone slower" (Advice 13). In the other case, he will be advised "anticipate, you could have gone faster" (Advice 14). When there has been no quick succession of deceleration and acceleration, it is verified whether acceleration has been followed by deceleration within a predetermined period of time (s sec.). If that is the case, the driver is advised "try to anticipate" (Advice 15). If that is not the case, it is verified whether "creeping" and "idling" have taken place in succession. If that is not the case, no recommendation is made, and

in the other the case it is verified whether the total duration thereof has been longer than 20 seconds. If that is not the case, no recommendation is made, in the other case the driver is advised "stop and turn off the engine" (Advice 16).

In the above-described manner recommendations can be generated at any point in time while driving, which recommendations may or may not be presented to the driver of the vehicle via the interface means.

Figure 6 shows a diagram wherein it is verified on the basis of safety considerations whether or not a particular recommendation is to be presented to the driver. This concerns Advive 3 (accelerate faster) and Advice 14 (anticipate: you could have gone faster).

According to the diagram of Figure 6 it is first ascertained whether either one of the two recommendations is under consideration, and if this is the case, the so-called TTC (Time to Collision) is calculated. The TTC is the time it would take before the vehicle would collide with a vehicle ahead if the difference in speed would remain constant. This time depends on the difference in speed and the distance between the vehicles, which factors can both be measured by means of a radar in the vehicle.

The diagram shows that if the TTC is less than a predetermined value (T sec.), no recommendation is made. If not, the relevant recommendation (Advice 3 or Advice 14) may be made.

The diagram of Figure 7 shows the manner in which it is determined to present a positive communication (Advice 18), for example a green light or a positive sign or text on the display screen or a spoken text informing

the driver that his driving style is satisfactory. As is shown in the diagram, this communication is presented as soon as no recommendation has been made for 5 minutes, that is, either no positive communication has been presented for 5 minutes (Advice 18) or no recommendation in connection with deviations form the normative driving style has been presented during that period.

Figure 8 shows a diagram which represents the selection of recommendations. Recommendations which cannot be presented to the driver for some reason are stored. It is verified constantly, for example every second, whether a recommendation has been stored in the buffer for more than 1 minute, and if that is the case, said recommendation is removed ("deleted"). Then the recommendations in the buffer are selected on the basis of the highest status, that is, on the basis of the priority that is awarded to the recommendations on the basis of certain criteria. Every recommendation is awarded a particular status thereby, Advice 3, 4 and 8, for example, are awarded "status 1", Advice 0, 1, 2, 5, 6 and 7 are awarded "status 2" and Advice 13, 14, 16 and 16 are awarded "status 3".

If there is only one recommendation which has the highest status, that recommendation is presented, and if there is more than one recommendation with the highest status, the most recent recommendation is presented. As soon as said most recent recommendation has been presented, it is determined anew in accordance with the diagram of Figure 8 which recommendation is to be presented next. When no recommendations are stored in the buffer, and that situation has lasted for more than five minutes, the positive communication is presented (Advice 18) in accordance with the diagram of Figure 7.

The diagrams as shown in the figures are to be

considered as mere embodiments, which only serve to explain the invention.

CLAIMS

1. A system of advising the driver of a motor vehicle as regards the efficiency of his or her driving style while driving, comprising registration means for determining internal factors of the vehicle, calculating means for determining on the basis of the determined factors to what extent the driver's actual driving style deviates from a normative driving style, whereby the actual driving style and the normative driving style are determined by the calculation means while driving on the basis of factors determined by the registration means, and interface means for presenting recommendation signals to the driver.

2. A system according to claim 1, characterized in that said registration means include one or more of the following means:
   - means for determining the vehicle speed;
   - means for determining the transmission ratio;
   - means for determining the braking force being exerted upon braking of the vehicle;
   - means for determining the acceleration/deceleration of the vehicle;
   - means for determining the gas pedal position;
   - means for determining the steering wheel position;
   - means for determining the angular speed of the steering wheel;
   - means for determining the bends which the vehicle takes;
   - means for determining the use or non-use of the clutch;
   - means for determining the engine speed;
   - means for determining the fuel consumption of the vehicle.

3 A system according to any one of the preceding claims, characterized by detection means for determining ambient factors.

4. A system according to claim 3, characterized in that said detection means include one or more of the following means:

- means for determining the gradient of the road on which the vehicle is driving;
- means for determining the allowed maximum vehicle speed;
- means for determining the distance to a vehicle ahead;
- means for determining the difference in speed with a vehicle ahead;
- means for determining the position of the motor vehicle;
- means for determining the direction of movement of the motor vehicle.

5. A system according to any one of the preceding claims, characterized in that said calculation means constantly determine the status, such as reversing, turning, overtaking, lane changing, parking, idling, creeping, shifting, uphill driving, downhill driving, accelerating, decelerating, cruising while driving, for example every period of less than 2 seconds, more preferably every period of less than 1 second.

6. A system according to any one of the preceding claims, characterized in that the average value of a factor is constantly determined after a predetermined period.

7. A system according to any one of the preceding claims, characterized in that a vehicle speed-

dependent minimum acceleration is determined for the normative driving style, which minimum normative acceleration is higher when the vehicle speed is lower.

8. A system according to claim 7, characterized in that said minimum normative acceleration is higher than 0.8 m/s2 when the vehicle speed is less than 20 km/h, and less than 0.8 m/s2 when the vehicle speed is more than 60 km/h, and more preferably the minimum normative acceleration value is higher than 1 m/s2 when the vehicle speed is less than 20 km/h and lower than 0.6 m/s2 when the vehicle speed is more than 60 km/h.

9. A system according to any one of the preceding claims, characterized in that a maximum deceleration value is determined for the normative driving style, which maximum normative deceleration value is preferably less than 0.45 g, more preferably less than 0.35 g.

10. A system according to any one of the preceding claims, characterized in that said calculation means constantly calculate the fuel consumption and/or the possible motor output that can be expected when a higher gear position is used at the actual vehicle speed or the actual acceleration/deceleration.

11. A system according to any one of the preceding claims, characterized in that said interface means are capable of producing a number of predetermined visual and/or auditive recommendation signals.

12. A system according to any one of the preceding claims, characterized in that said recommendation

signals contain a recommendation to the driver to carry out an action and/or to change his driving style, which recommendation is selected from a number of predetermined recommendations.

13. A system according to any one of the preceding claims, characterized in that it is calculated by the calculation means and presented by the interface means to what extent the driver's actual driving style deviates from the normative driving style and/or which of a number of predetermined recommendations is to be presented to the driver in order to induce him to improve or otherwise adapt his driving style.

14. A system according to any one of the preceding claims, characterized in that it is calculated by the calculation means and presented by the interface means how large the difference is between the actual fuel consumption and the normative fuel consumption as calculated by the calculation means, preferably over a predetermined period of time which is preferably shorter than 10 minutes, more preferably shorter than 5 minutes.

15. A system according to any one of the preceding claims, characterized in that setting means are present for setting the minimum deviation of the actual driving style from the normative driving style above which a recommendation or other information will be presented to the driver.

16. A system according to any one of the preceding claims, characterized in that the interface means issue a positive communication when the actual driving style has not substantially deviated from the normative driving style for a particular period

of time, preferably a period of less than 10 minutes, more preferably a period of less than 5 minutes.

17. A system according to any one of the preceding claims, characterized in that verification means are present which verify whether a particular recommendation signal can be delivered before said recommendation signal is actually delivered by the interface means, whereby the recommendation signal cannot be delivered during one or more of the following situations: turning, parking, overtaking, reversing, braking, approaching a vehicle ahead more quickly than a predetermined value, accelerating while approaching a vehicle ahead more quickly than a predetermined value.

18. A system according to claim 17, characterized in that a non-delivered recommendation is stored, and after a predetermined period of time, preferably a period of less than 2 seconds, it is verified anew whether the recommendation can be delivered as yet.

19. A system according to any one of the preceding claims, characterized in that verification means are present which may block the delivery by the interface means of a recommendation to drive faster when a vehicle ahead is being approached more quickly than a predetermined value.

20. A system according to any one of the preceding claims, characterized in that means are present for classifying recommendations which are simultaneously available for delivery by the interface means on the basis of predetermined criteria, such as shifting gear has priority over

accelerating/decelerating..

21. A method of advising the driver of a motor vehicle as regards the efficiency of his or her driving style while driving, wherein registration means determine vehicle factors, wherein calculation means determine on the basis of predetermined factors to what extent the actual driving style deviates from a normative driving style, wherein the actual driving style and the normative driving style are determined while driving by said calculation means on the basis of factors determined by said registration means, and wherein interface means make recommendation signals available to the driver.

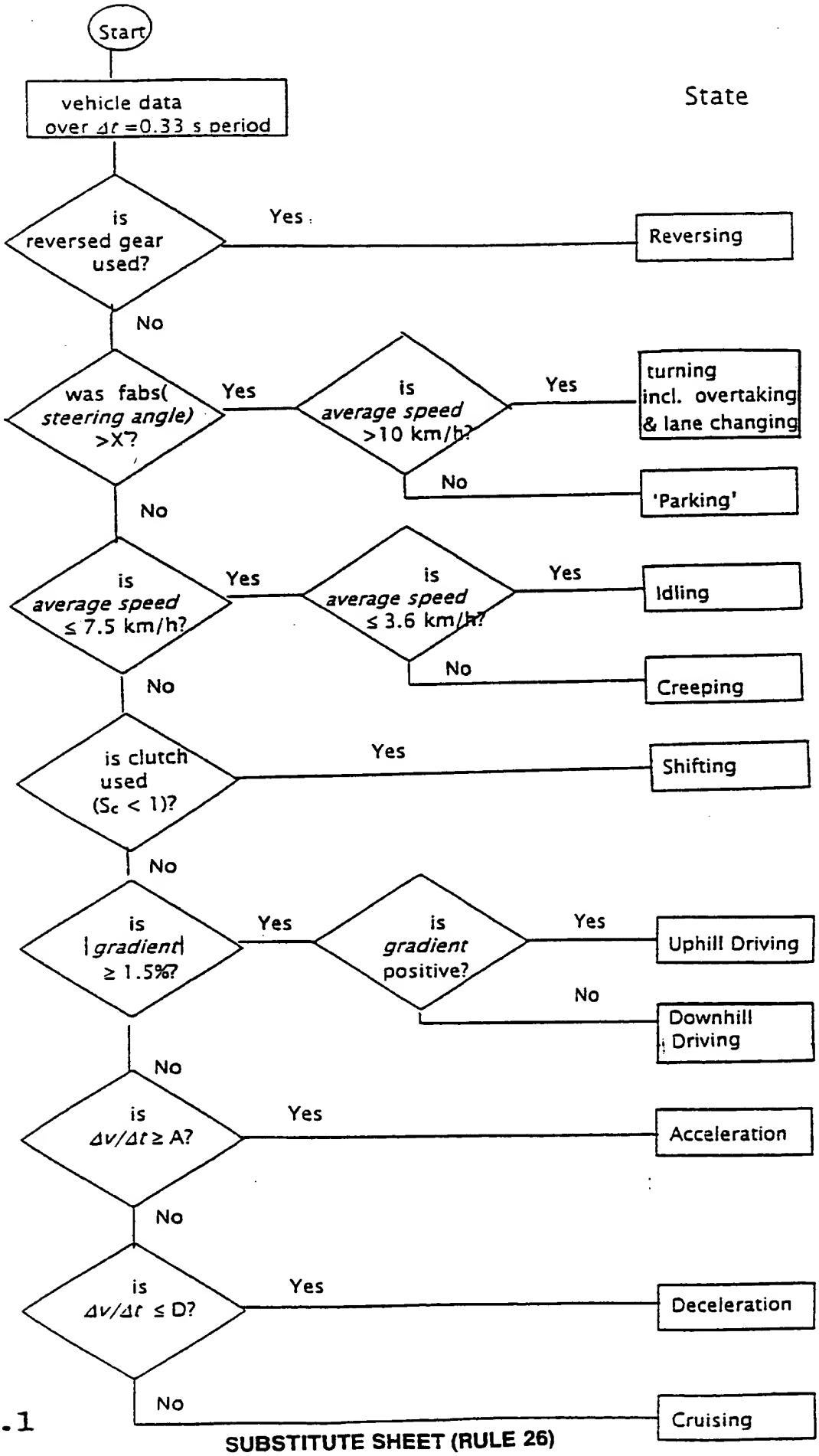

Fig.1

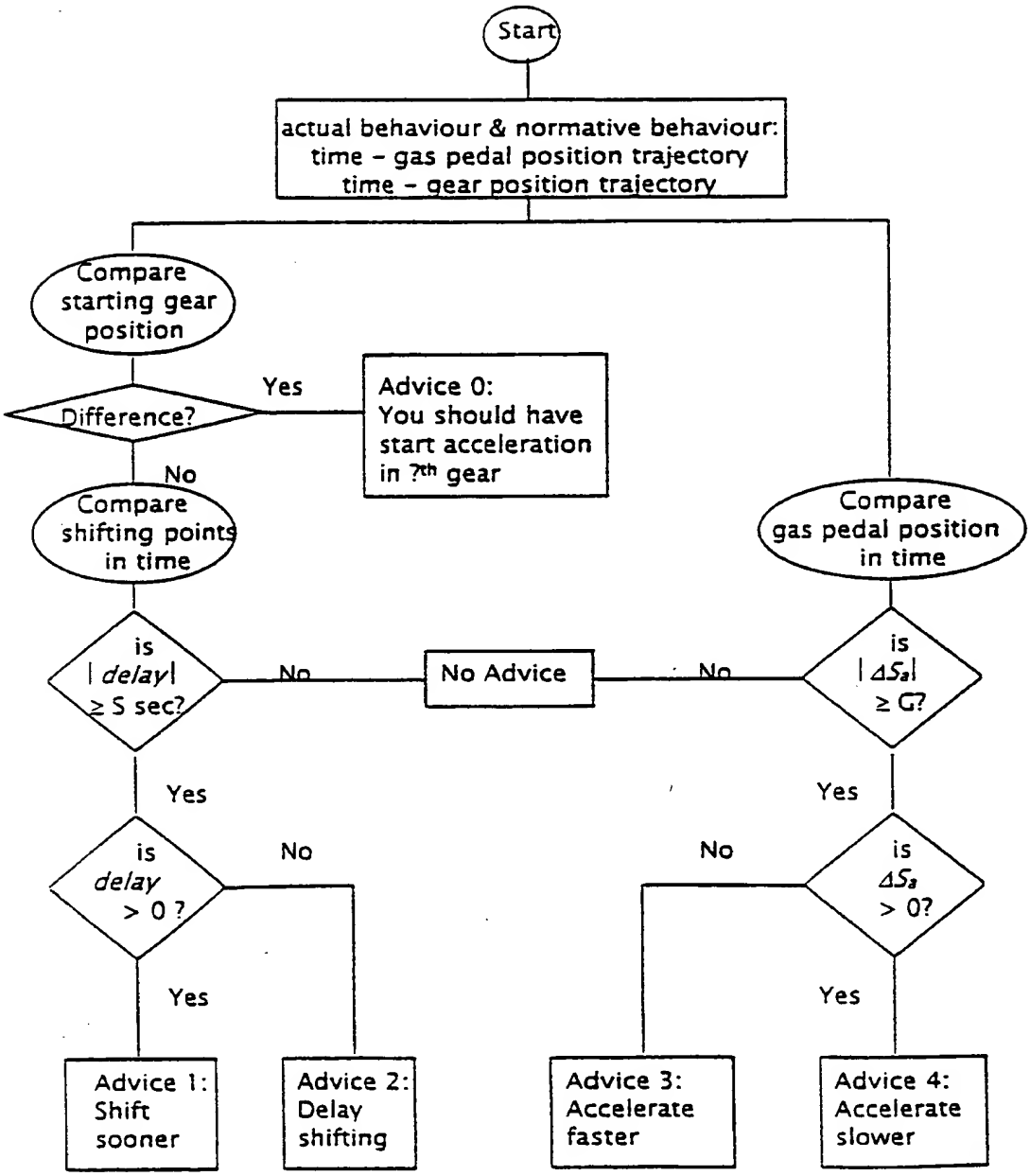

Fig.2

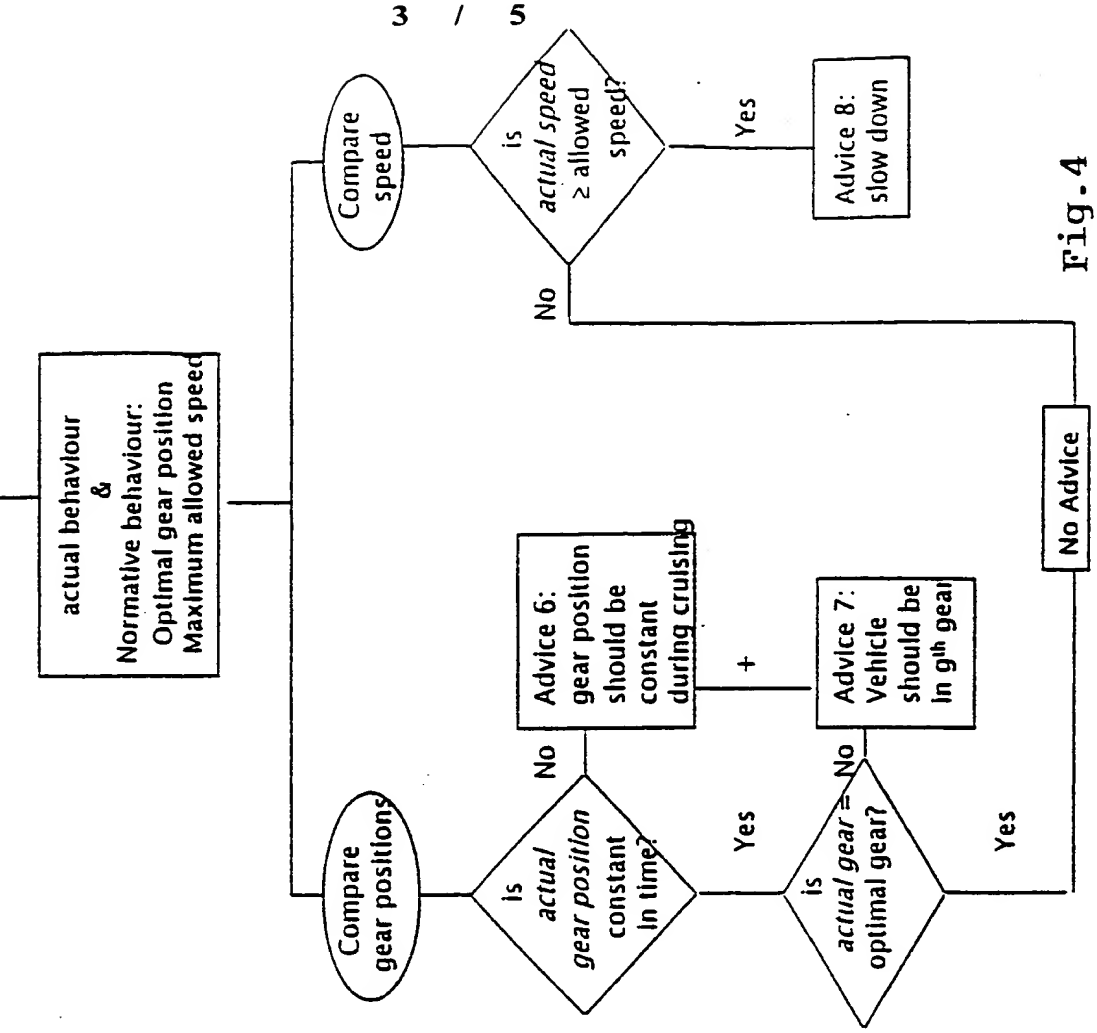

Fig.4

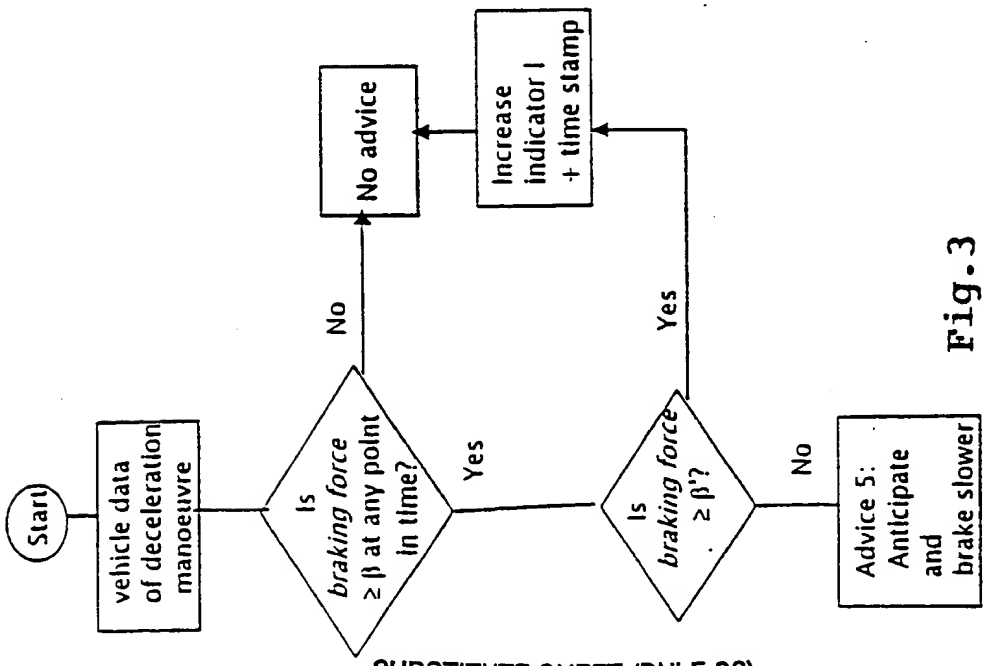

Fig.3

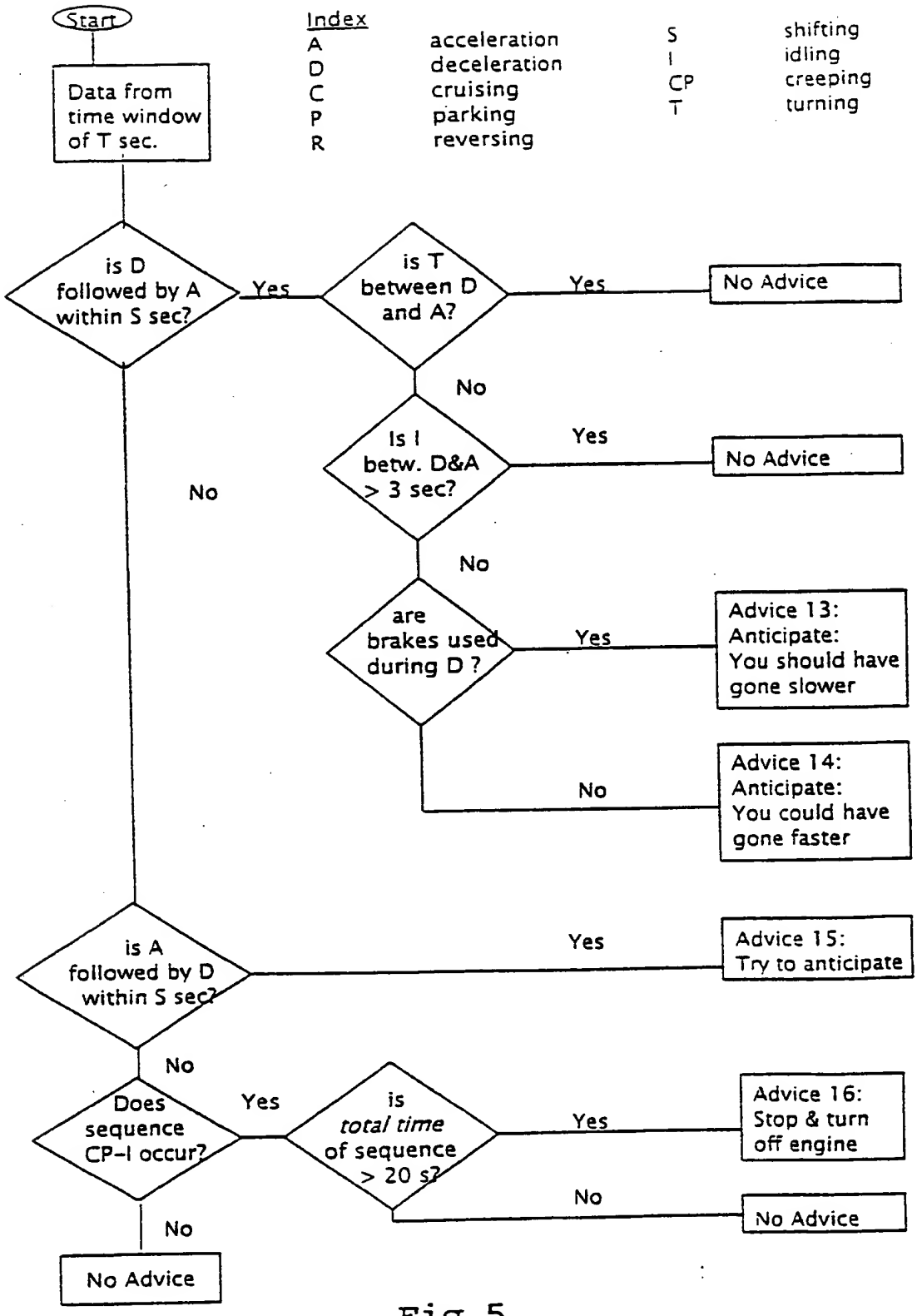

Fig.5

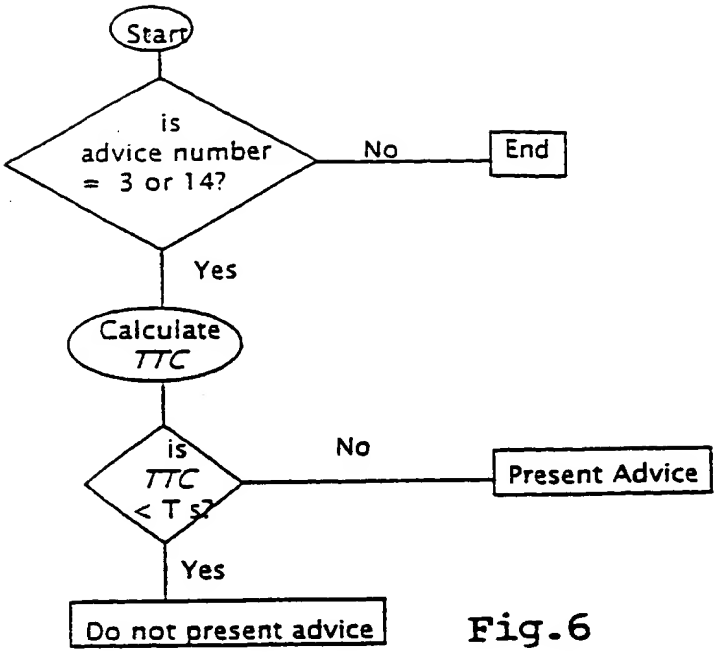

Fig.6

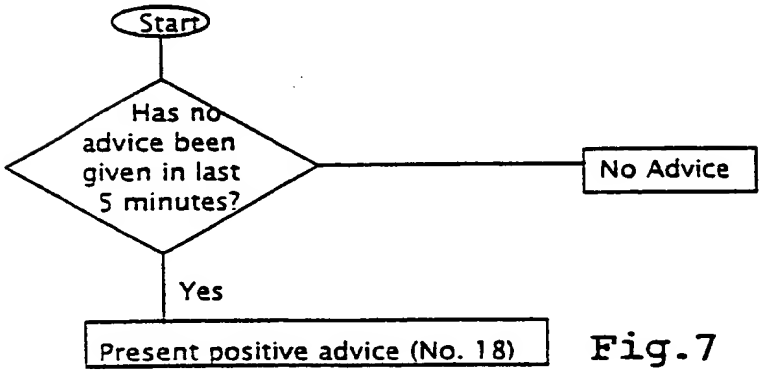

Fig.7

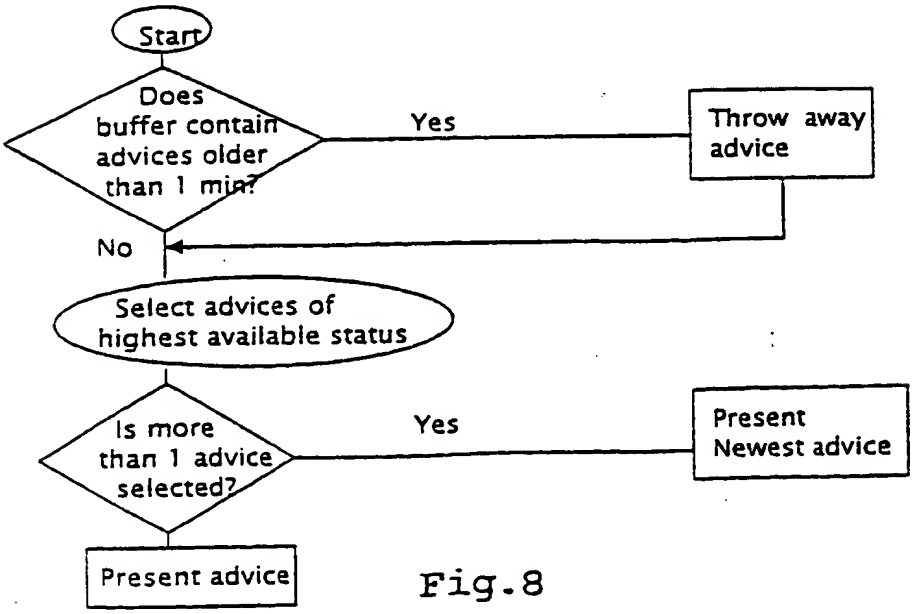

Fig.8

INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/NL 99/00464

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G07C5/00 B60K31/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G07C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 95 05649 A (VORAD SAFETY SYSTEMS INC) 23 February 1995 (1995-02-23) abstract; claims; figures page 17, line 18 -page 20, line 25 page 56, line 30 -page 58, line 19	1-4, 10-13,21
A	---	5
X	DE 197 00 353 A (KERSANDT DIETHARD) 9 July 1998 (1998-07-09) abstract; claims; figures column 2, line 21 -column 4, line 46	1,3,11, 12,21
A	---	2,4,5
X	DE 43 38 073 A (DAIMLER BENZ AG) 11 May 1995 (1995-05-11) abstract; claims; figures column 5, line 24 -column 7, line 12	1,21
A	---	2
	-/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 October 1999	04/11/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl. Fax: (+31–70) 340–3016	Meyl, D

1

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Int ional Application No
PCT/NL 99/00464

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 92 03803 A (SSES AB) 5 March 1992 (1992-03-05) page 5, line 20 -page 6, line 2 page 6, line 14 - line 27 page 8, line 22 -page 9, line 24; figure	1,3,21
A		1,4,5,19
X	DE 44 20 469 A (ZELTNER STEFAN DIPL ING FH) 14 December 1995 (1995-12-14) abstract; claims; figures column 2, line 31 -column 4, line 26	1,11,21
A		2,3
X	EP 0 023 283 A (KIENZLE APPARATE GMBH) 4 February 1981 (1981-02-04) abstract; claims; figures	1,21
A		2
A	US 5 162 997 A (TAKAHASHI HIROSHI) 10 November 1992 (1992-11-10)	
A	EP 0 145 280 A (FLOSCAN INSTR CO) 19 June 1985 (1985-06-19)	
A	US 4 412 594 A (FURUKAWA YOSHIMI ET AL) 1 November 1983 (1983-11-01)	

1

INTERNATIONAL SEARCH REPORT

.formation on patent family members

Int tional Application No
PC I/NL 99/00464

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9505649 A	23-02-1995	US 5465079 A	07-11-1995
		AU 677858 B	08-05-1997
		AU 7396494 A	14-03-1995
		BR 9407460 A	12-11-1996
		CA 2169262 A	23-02-1995
		EP 0713595 A	29-05-1996
		JP 9501784 T	18-02-1997
DE 19700353 A	09-07-1998	NONE	
DE 4338073 A	11-05-1995	EP 0653730 A	17-05-1995
WO 9203803 A	05-03-1992	EP 0560770 A	22-09-1993
		JP 6500414 T	13-01-1994
DE 4420469 A	14-12-1995	NONE	
EP 0023283 A	04-02-1981	DE 2928318 A	22-01-1981
		AT 10235 T	15-11-1984
		JP 56019429 A	24-02-1981
		US 4354173 A	12-10-1982
US 5162997 A	10-11-1992	JP 2940042 B	25-08-1999
		JP 3224832 A	03-10-1991
		DE 4101902 A	01-08-1991
		GB 2240194 A,B	24-07-1991
EP 0145280 A	19-06-1985	DE 3473347 A	15-09-1988
		JP 60119418 A	26-06-1985
		US 4706083 A	10-11-1987
US 4412594 A	01-11-1983	JP 57044568 A	13-03-1982
		JP 1369727 C	25-03-1987
		JP 57060974 A	13-04-1982
		JP 61035020 B	11-08-1986
		JP 57070774 A	01-05-1982
		DE 3133985 A	18-03-1982
		FR 2495088 A	04-06-1982
		GB 2083422 A,B	24-03-1982